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Economic welfare analysis of policy-induced structural change in the Indonesian poultry industry

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Abstract

The performance of the poultry industry in Indonesia is analyzed in terms of changes in producer and consumer welfare as a result of public policy intended to limit the size of production units in order to distribute growth opportunities to smaller farms. Elasticities of supply and demand are estimated using the seemingly unrelated system of equations. The hypothesis of a policy-induced structural change, estimated through a dummy variable accounting for a shift in supply associated with implementation of the policy, shows a negative impact on the output supplied and the welfare of producers and consumers to the tune of about Rp 94 billion or roughly about 0.1% of national income as of 1983. The study suggests an important trade-off between more equitable income distribution and economic efficiency. © 1997 Elsevier Science B.V.

1. Introduction and problem statement

Government intervention is frequently motivated by objectives of equity in the distribution of income, wealth or economic opportunity. But such policies may also produce unwanted side-effects resulting in trade-offs in terms of reduced levels of efficiency and losses in producer and consumer welfare. It is important that governments recognize these trade-offs and take them into account in designing such policies. This article examines the welfare implications of policies pursued by the government of Indonesia during the 1980s which had the aim of re-distribution economic opportunity among producers in their rapidly developing poultry industry.

Much of the growth of the Indonesian poultry industry during the past 2 decades occurred through

large, vertically integrated production units controlled by feed manufacturers and/or processing companies (Lasley, 1983; Atmadja and Mihardja, 1983). Initially, in the 1970s the government employed an incentive approach to increase the participation of smaller producers through technology transfer and credit schemes. By the 1980s, however, the exclusion of many small, independent producers from this development became a source of concern for the government which then tried to regulate the scale of chicken production through the policy known as *Keppres 50/1981* introduced in 1981. The aim of this policy was to mitigate the less desirable aspects of vertical integration and to increase the participation of a larger number of producers by limiting the size of production units. Large-scale farms and co-operatives were also required to diversify into feed making and poultry breeding in order to supply these essential inputs to smaller independent producers. This latter aspect was further empha-

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sized through a modification of the policy in 1984, creating what was known as the nucleus farming system (NFS). In this system, the larger enterprise or the co-operative was expected to promote the development of smaller, independent producers through marketing their product as well as supplying them with inputs.

The policy, *Keppres 50/1981*, restricting the scale of enterprise, was criticized for ignoring efficiency and economies of scale considerations. As observed by Rusastra et al. (1988) it also appears to have done little to restrict the growth of vertical integration, with an apparent increase in the proportion of broiler production under contract during the 1980s. In 1990, the government responded to pressure to increase output more rapidly by increasing the maximum scale of broiler chicken production to 15 000 birds per cycle. Further deregulation has since occurred with the industry now developing under an export orientation. Given this history of policy changes, it is hypothesized that the regulatory policy, *Keppres 50/1981*, and its variations which existed during the 1980s, caused a backward shift in the poultry supply function in Indonesia, thereby reducing aggregate producer and consumer welfare.

2. Methodology

Possible effects of structural and/or technological change in the industry can be viewed as a shift in the supply curve. Government policies which influence the size of production units may also influence the position and/or slope of the supply curve. To evaluate the implications of such a change, economic welfare analysis can be used effectively to analyze equity as well as economic efficiency aspects of policy (Tweeten, 1989). The interaction between demand and supply in the perfect competition model provides the foundation for welfare analysis.

2.1. Model specification

The poultry meat industry in Indonesia is treated as a unified and closed market under the partial equilibrium analysis framework. Since there is incomplete information regarding the amount of storage or stocks, and trade, the following assumptions

are made: (1) total quantity of poultry meat supplied is equal to that demanded for consumption (i.e. market clearing condition); (2) prices are determined in the domestic market and (3) consumers are indifferent between commercial broiler chicken and traditional chicken which forms part of the supply.

Given the above assumptions, the Indonesian poultry market can be described in a highly simplified partial equilibrium model comprising of a system of the following three equations:

$$\begin{aligned} \text{QSUP}_t &= f(\text{WHCP}_{t-s}, \text{CORP}_{t-s}, \text{TIME}, \text{DUMI}, \text{PDUM}) \end{aligned} \quad (1)$$

$$\text{QDEM}_t = g(\text{WHCP}_t, \text{BEEF}_t, \text{INCM}_t) \quad (2)$$

$$\text{WHCP}_t = h(\text{WHCP}_{t-s}) \quad (3)$$

where

QSUP_t and QDEM_t represent the per capita quantity of chicken produced (supplied) and consumed (demanded), respectively, in the current year t (kg per capita year⁻¹).

WHCP_t is the real wholesale price of chicken lagged 6 months in the supply equation and taken for the current period in the demand equation ('000 Rp (1983) kg⁻¹).

CORP_{t-s} is the real domestic wholesale price of corn with a 6 months lag (mid year) (Rp (1983) kg⁻¹).

TIME is a time trend variable proposed as a proxy for productivity and technology improvements in production.

DUMI_t is a dummy variable which serves as a proxy to represent the supply function associated with the policy implementation.

PDUM is an interaction term between WHCP and DUMI .

BEEF_t is the real wholesale price of beef, as a substitute for chicken in the current period ('000 Rp (1983) kg⁻¹).

INCM_t is income per capita per year (Rp per capita year⁻¹).

t is current period (year) and $t-s$ is 6 months earlier.

For simplicity of modelling the supply response is based on naive expectations of price. To have the market clear, the current wholesale price must be

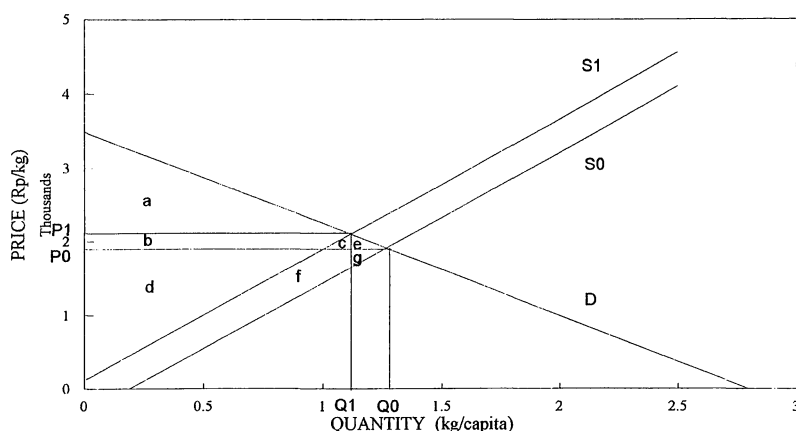


Fig. 1. Consumers' and producers' surplus at the wholesale level. P_0 , Q_0 = equilibrium price and quantity, respectively, before the supply shift (S_0). P_1 , Q_1 = equilibrium price and quantity, respectively, after the supply shift (S_1). Source: adapted from Hertford and Schmitz (1977).

estimated as a function of the lagged wholesale price (WHCP) used to determine the level of output. The results of this estimation (Eq. (3)) are used to estimate demand (Eq. (2)). The above model specification is used to obtain updated and relevant estimates of demand and supply elasticities which are the crucial inputs used in the welfare calculations. Given its simplicity the estimates obtained from this model will be evaluated against those found in the literature.

One of the ways of evaluating the effect of policy change ex-post is to identify and estimate the shift in the supply.¹ The critical point for supply shift is 1981, which delineates the pre- and post-restriction policy, the *Keppres 50/1981*. It is assumed that, although the policy was officially lifted in 1990, its impact was still in effect until 2 years later, i.e. until 1992.

2.2. Producers' and consumers' surplus

To estimate total welfare effects due to a policy change which shifts supply, the change in consumers' and producers' surplus may be combined. Fig. 1 contains a demand curve, D , and an initial supply curve, S_0 , which is presumed to shift to the position S_1 as a result of the *Keppres 50/1981* policy. Due to the shifting of the supply curve the consumers' surplus changes from the area 'a + b + c + e' to area 'a', and the producers' surplus is altered from the area 'd + f + g' to 'b + d'. Consequently the net change in economic welfare is equal to '−c − e − f − g'. To calculate these welfare changes the approximation formulas developed by Hertford and Schmitz (1977) will be used.²

3. Data and estimation

The data used in the analysis cover the period 1972–92 and were obtained from various sources

¹ A less restrictive alternative would be to estimate the model prior to the period of the policy change and then after the period of the policy change and test it for significant structural change by the Chow test. However, the Chow test requires the homogeneity of the variances over the two periods (Gujarati, 1988). The chi-square value of 20.2 under the Bartlett's homogeneity-of-variance test (as described in Gujarati, 1988, p. 344) clearly rejected the null hypothesis (at 1% level of significance) of the homogeneity of the two variances. Thus as per Toyoda (1974) the Chow test in this case is not applicable. Moreover considering low number of degrees of freedom (for example, only 5 in the first period) it was decided to estimate the model over the entire 21-year sample period and use the supply shift dummy variable.

² According to Hertford and Schmitz (1977) (a) change in consumers' surplus = $[kP_1Q_1/(\eta + \varepsilon)][1 - 0.5k\eta/(\eta + \varepsilon)]$, (b) change in producers' surplus = $(kP_1Q_1)\{1 - [1/(\eta + \varepsilon)][1 - 0.5k(2\eta + \varepsilon)/(\eta + \varepsilon)]\}$, (c) total welfare change = $kP_1Q_1[1 + 0.5k/(\eta + \varepsilon)]$, where k is percentage increase or decrease in production attributable to the policy change (i.e. the horizontal distance between two supply curves divided by the value of final production Q_1), P_1 is the price of the commodity after the supply shift, η is the absolute price elasticity of demand and ε is the price elasticity of supply.

such as the Directorate General of Livestock Service, Ministry of Agriculture of Indonesia (1987, 1991), the Central Bureau of Statistics, National Bureau of Logistic and Indonesia country report of the World Bank (1992). Since much of the data are reported on an annual basis only, all other data were converted to the same basis. In the case of wholesale and retail prices for chicken, for example, the data for 1980–1992 were compiled from monthly series, while the data prior to this period were available only as annual averages. For the lagged prices from annual data (before 1980) estimates for the previous 6 months were created using mid points between the annual average for the present year and the previous year. In addition, since price data are not available in all provinces, the data on prices are only from the provinces of Java, Sumatra and Kalimantan which amount for the majority of chicken production. The details are also given in Suwartini (1994).

Unlike wholesale and retail prices, information regarding producer prices is generally not available in published form. In lieu of published data, a series of producer prices was derived through marketing margins based on the report of Aziz (1987). His study, conducted in Java for the period between 1980 and 1984, indicated that the producer price was approximately 76% of the retail price and 93% of the wholesale price. The supply and demand relations were estimated at the wholesale level, primarily because of availability and quality of price data at this level. The price elasticities of supply and demand at the wholesale level are determined from the estimated models (Eqs. (1) and (2)). The price elasticity at the producer and retail levels are derived from those of the wholesale level through the assumption of constant marketing margins. Under the condition of a perfectly elastic supply for services, marketing margins between retailer and producer can be expected to remain constant as quantity of a commodity marketed increases or decreases (Kilmer, 1986).

The econometric method used to estimate the model is seemingly unrelated regressions (SUR), also known as the Zellner estimation. Kmenta (1971) proposed a methodology for employing SUR on the basis that a system of equations related only through mutual correlation of disturbance terms would be regarded as seemingly unrelated. For estimation purposes, it is assumed that the covariance of distur-

bance terms is constant over all distributions. With the assumptions of the classical linear regression model, the SUR estimators of the parameters are said to be unbiased and efficient (Kmenta, 1971).

4. Results and analysis

4.1. Supply

Assuming a fixed relationship (constant proportion) between farm level production and wholesale level shipments, farm production is used as a proxy for supply at the wholesale level. The SUR estimation of supply at the wholesale level yielded an R^2 of 0.98 with most explanatory variables significant (see Table 1). The coefficient of the lagged wholesale chicken price variable ($WHCP_{t-s}$) has the expected positive sign and yields a price elasticity of 0.69 calculated at the mean. The time variable, as a

Table 1
Estimation results for supply, demand and price relationship at the wholesale level: Indonesian poultry industry, 1972–1992^a

Explanatory variables	Supply ($CHIQ_t$) ^b	Demand ($CHIQ_t$) ^b	Price relation ($WHCP_t$) ^b
Intercept	–1.78 (1.57) ^c	–1.57 (1.39)	193.59 (1.47)
$WHCP_{t-s}$	0.0005 (3.52) **		0.89 (12.21) **
$WHCP_t$		–0.0008 (2.23) *	
$TIME_t$	0.17 (19.38) **		
$CORP_{t-s}$	0.001 (1.87)		
DUMI	–0.26 (2.98) *		
BEEF _t		0.0003 (3.81) **	
INCM _t		0.009 (15.97) **	
R^2	0.98	0.95	0.88
No. observations	21	21	21

^a This system of three equations is estimated by using the seemingly unrelated regressions (SUR) method.

^b Dependent variable.

^c *t*-statistics in parentheses.

** Significant at 1%; * significant at 5%.

proxy for technological change, is related positively to output at the 1% level of significance indicating that technology and/or productivity improvements in the Indonesian poultry industry contributed to increased supply over time.

The significant coefficient of the dummy variable (DUMI) indicates that there has been a structural change in the poultry industry associated with the policy implementation. The negative sign of this coefficient implies that the policy-induced structural change had an adverse impact on output. The interaction term of wholesale chicken price and dummy variable was found non-significant and was not retained in the final model.

Feed is an important input in chicken production. However, based on the model specification and data sample used in this study, the coefficient of the lagged-corn price ($CORP_{t-s}$) representing input costs is found non-significant at the 5% level. This may be a statistical phenomenon since domestic corn prices were relatively stable and showed a similar trend to that of chicken prices in the period of study.

4.2. Demand

The estimated demand for chicken at the wholesale level also performs well; the R^2 is 0.95 and each of the explanatory variables is significant. The current wholesale price used in the demand model is

generated from lagged-wholesale prices through the price-relations model. The price relations model exhibited an R^2 of 0.88 (see Table 1).

The coefficient for the current wholesale chicken price ($WHCP_t$) has the expected negative sign and is significant at the 5% level. The price elasticity at the wholesale level is -1.04 , evaluated at the mean. Beef price ($BEEF_t$) is significant at 1% with the expected positive sign, indicating that beef is a substitute for chicken. The per capita income variable ($INCM_t$) is significant at 1% level and yields an income elasticity of 2.8. Thus, the demand for chicken meat in Indonesia can be characterized as being highly elastic with respect to per capita income.

4.3. Supply and demand elasticities

The results of elasticity analysis for supply and demand at the producer, wholesale and retail levels are presented in Table 2. Price elasticities of demand and supply evaluated at the mean for all three levels are used to evaluate the effect of the *Keppres 50/1981* policy. At all levels, the demand function is relatively more price responsive than the supply function indicating a stable and converging equilibrium prices under this cobweb model.

The elasticity estimates reported by other researchers in similar situations are also shown in

Table 2
Chicken demand and supply elasticity estimates at producer, wholesale and retail levels in Indonesia and comparison with other studies

	Country	Data period	Demand elasticity	Supply elasticity
At producer level		1972–92	–0.66	0.44
At wholesale level			–1.04	0.69
At retail level			–1.02	0.73
<i>Comparison with other studies</i>				
Capps et al. (1994)	Japan	1962–91	–0.45	n.a.
	Korea		–0.47	n.a.
	Taiwan		–0.28	n.a.
Sullivan et al. (1989) ^a	Mexico	1980–90	–1.10	0.70
	India		–0.30	0.40
Mdafri and Brorsen (1993)	Morocco	1968–85	–1.26	n.a.
Hayes et al. (1990)	Japan	1962–86	–0.59	n.a.
Wahl et al. (1992)	Japan	1962–89	–0.91	n.a.
Suryana and Marisa (1987)	Indonesia	1987	–0.47 to –0.84	n.a.

^a Based on survey of other studies.

n.a., not applicable or reported.

Table 2. The price elasticity of demand at the retail level (1.02) found here is larger, in absolute terms, than the estimates (between 0.47 to 0.84) found by Suryana and Marisa (1987). However, their analysis was based on the cross-sectional data. As evidenced from the selected recent literature the demand elasticity estimates for poultry have varied from 0.45 for Japan to 1.26 for Morocco. The elasticity of 1.10 for Mexico, a country at a similar level of economic development, is quite close to the estimate obtained for Indonesia from the simple model used in this study.

The supply elasticity at the wholesale level is calculated to be 0.69. Unfortunately, not many studies reporting supply elasticities in similar situation could be found for comparison. As one example, Sullivan et al. (1989) reported poultry supply elasticity of 0.70 for Mexico. Thus, based on a limited empirical information, the elasticities used in this study fall within a plausible and acceptable range.

4.4. Welfare estimation

The changes in consumers' and producers' welfare are estimated using the approximation formulas given by Hertford and Schmitz (1977) and the supply and the demand elasticities calculated earlier. As shown in Table 3, at the wholesale level, the loss of consumers' surplus is estimated at 289 rupiah (1983) per capita or approximately 45.2 billion rupiah in total when evaluated at the 1983 population level of 156.3 million. On the producers' side, there is a

welfare loss of 314 rupiah (1983) per capita or approximately 49.1 billion in total. Hence, the aggregate annual loss to society at this level is approximately 603 rupiah per capita or 94.3 billions in total, as of 1983. Assuming the same rate of loss per capita, the total loss by 1990 would be Rp 94 billion year⁻¹ in 1983 constant rupiah.

To get closer to the welfare losses to growers (farm level), changes in producer surplus may be estimated using supply and demand at the producer level. On this basis, welfare losses to producers (growers) are estimated at Rp 135 per capita or 24.1 billion rupiah in total in 1983. This is almost half the loss in producers' surplus estimated at the wholesale level and represents about 8% of the average value of annual production during the period under study.

At the retail level, the loss in consumers' welfare is Rp 349 per capita or Rp 54.5 billion as of 1983. The aggregate loss in consumer welfare is thus two and one half times that of producer welfare loss. The implicit economic loss to the marketing intermediaries for the reduced volume of output is in the order of Rp 119 per capita or Rp 18.6 billion. In other words, these intermediaries (processors, wholesalers and retailers) are likely to encounter a loss of gross revenue equivalent to 20% of the total loss in producers' and consumers' surplus. However, this is likely an overestimate since part of this is offset by reduced marketing costs due to smaller volume. To put these welfare losses to society in proper perspective, they represent approximately 0.1% of total income.

From the results of the analysis, it appears that despite its objective of assisting producers, a restrictive policy of this nature can actually lead to a decrease in aggregate producer welfare. In this case the total loss in producer (grower) welfare represents about 22% of the total loss to society.

5. Summary and conclusions

This study has investigated the extent to which the *Keppres 50/1981* policy may have affected the aggregate welfare of producers and consumers of chicken in Indonesia. It is based on a simple partial equilibrium model estimated using time series data for 1972 to 1992. The magnitude of the welfare loss

Table 3
Welfare changes (1983 constant Rp per capita) due to *Keppres 50/1981* at the producer, wholesale and society level

	Wholesale level (no middlemen)	Farmgate supply and retail demand
Change in consumers' surplus	-289	-349
Change in producers' surplus	-314	-135
Total consumer and producer surplus	-603	-484
Welfare gain to middlemen	-	-119 ^a

^a The implicit 'welfare loss' calculated for middlemen is equal to the total social welfare evaluated at wholesale level (Rp 603) minus that estimated for producers at the farmgate and consumers' at the retail level (Rp 484). This 'welfare loss' is partly compensated by lower marketing costs associated with reduced volume and thus is likely to overestimate the true loss.

attributed to this policy is estimated to be in the order of 600 rupiah (1983) per capita or approximately 94 billion rupiah as of 1983. These losses are shared primarily by producers and consumers with some losses also borne by the marketing sector (processors, wholesalers and retailers). The estimated aggregate loss of 21.1 billion rupiah experienced by producers as of 1983 corresponds to 8% of average annual total producer revenue for chicken meat production. The estimated loss of 54.5 billion experienced by consumers at the same time corresponds to 14% of estimated consumer expenditure for chicken meat. The aggregate losses to the Indonesian population, however, amount to only about 0.1% of the total income.

This analysis of the production restricting policy has shown the price, in terms of the loss of economic efficiency, that society as a whole may have to pay in order to achieve the goal of more equitable income distribution. From the economic efficiency point of view, in terms of aggregate social welfare of both producers and consumers, it seems that abandonment of this restrictive policy was the appropriate decision by the government of Indonesia. Liberalization of such a restrictive policy is likely to result in gains of a corresponding magnitude.

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